The Government of
The Hong Kong Special Administrative Region

Standards and Calibration Laboratory

Calibration Services

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CALIBRATION SERVICES

1. General Information

1.1 The Standards and Calibration Laboratory (SCL) of the Government of The Hong Kong Special Administrative Region is responsible for maintaining the reference standards of measurement for Hong Kong. Through a non-profit calibration service, SCL provides traceability to its reference standards, complying with the requirements of ISO/IEC 17025 Standard.

1.2 The laboratories of SCL are situated at two different locations. The main laboratories complex is located at Immigration Tower. This complex includes :

Direct Current Laboratory

Low Frequency Laboratory

Radio Frequency Laboratory

Acoustics laboratory

Temperature Laboratory

Humidity Laboratory

Dimension Laboratory

Mass and Related Laboratory

The Force Laboratory is located at the G04 Public Works Central Laboratory Building, 2B Cheung Yip Street, Kowloon Bay, Kowloon.

1.3 All enquiries regarding calibration services should be addressed to :

Head, Standards and Calibration Laboratory
The Government of the Hong Kong Special Administrative Region
36/F Immigration Tower
7 Gloucester Road, Wan Chai
Hong Kong

Telephone : 2829 4830
Fax : 2824 1302
Website : http://www.itc.gov.hk/scl
Email address : scl@itc.gov.hk

1.4 Calibrations will normally be conducted in the SCL premises.

1.5 SCL reserves the right to accept or decline any application.

1.6 Equipment submitted for calibration should satisfy the following conditions :

(a) The equipment must be in clean condition.

(b) The equipment must be in good working order.

(c) The equipment must bear some unique permanent marking, such as a serial number. SCL will not normally issue a Certificate of Calibration for equipment without unique identification marking.

(d) The equipment must be accompanied by comprehensive operations and service manuals written in English or Chinese.

(e) The equipment must be accompanied by any specialised accessories required for its calibration.

1.7 SCL will not normally undertake any maintenance or repair work on the equipment. Where the equipment is found to be faulty, or to have developed a fault, before or during the provision of the calibration service (including any loading, unloading, carriage or transportation of the equipment), no calibration service or further calibration service will be provided. Where the calibration service cannot be provided or completed for whatever reason, a full or partial refund of the fee paid may or may not be made to the applicant, depending on the time and effort (if any) expended in providing the calibration service (including any loading, unloading, carriage or transportation of the equipment), as the Head of SCL may in his discretion determine.

1.8 The term "calibration" refers to the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of the measurement standards maintained by SCL. Unless otherwise stated, the fees quoted by SCL for the calibration of an equipment will not include "adjustment" of the equipment.

1.9 In certain circumstances, and at the discretion of SCL, minor adjustments to the equipment may be made to improve its performance or to bring it within specification. However, this will only be done upon special request by the applicant, and on the following conditions :

(a) the adjustment procedure is relatively straight forward,

(b) the procedure is clearly documented in the submitted service manual,

(c) the procedure will not result in a significant increase in the time required to complete the calibration,

(d) the equipment is accompanied by all the necessary accessories required to perform the adjustment, and

(e) an extra fee may be payable for such adjustments and re-calibration after adjustments.

1.10 The Government including its officers, employees, contractors and agents shall not be liable for any loss, destruction or damage (including without limitation consequential loss, destruction or damage) however arising from or in respect of the use or non-issue of any certificate and/or report referred to in para. 2, any loading, unloading, carriage, transportation, assembling, packing, unpacking, evaluation, testing, calibration, use, non-use or misuse of the equipment referred to in para. 1.6 in any period while the equipment is in the applicant's or the Government's or the Government's contractors' custody, possession or control, (including any period of loading, unloading, carriage and transportation), on any route to, from or at any laboratory, premises or property used for or in connection with the calibration of the equipment or the provision of any calibration service, other than caused by the fraud or malicious act of the Government, its officers, employees, contractors or agents. The applicant is advised (and acknowledges that advice) to take out adequate insurance (including but not limited to goods-in-transit insurance) to cover the risks of any loss, destruction or damage excluded by this condition.

1.11 The Government shall not be regarded as a common carrier or bailee for reward or otherwise in respect of the provision of the calibration service (including any loading, unloading, carriage or transportation of the equipment).

2. Certificate of Calibration

2.1 A Certificate of Calibration will normally be issued to the customer upon completion of the calibration.

2.2 The results given in the Certificate only relate to the values measured at the time of the calibration, and in the environmental conditions at the time. Any quoted measurement uncertainties will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, or the capability of any other laboratory to repeat the measurement.

2.3 The Government of the Hong Kong Special Administrative Region owns the copyright of the Certificate of Calibration. Such certificate shall only be reproduced in full unless prior written approval is obtained from the Head of SCL.

3. Procedure for Requesting Calibration Service

3.1 A prospective customer wishing to use the calibration service should contact SCL either by phone, e-mail, fax or letter, stating their requirements. SCL will then send an official quotation together with an "Application for Calibration" form. The conditions of service are set out on page 2 of the form.

3.2 If the customer wishes to proceed with the calibration, he should contact SCL to arrange a date for the delivery of the equipment. A crossed cheque made payable to the "The Government of the Hong Kong Special Administrative Region" is to be submitted together with the equipment and manuals.

3.3 Depending on the demand for particular calibration services at the time, it may take a short while before an equipment can be accepted for calibration. Customers are therefore advised to contact SCL early before their equipment calibration date is due.

3.4 A limited equipment collection and delivery service is available, free of charge, for small items of equipment, but this is subject to the availability of transport. Please note the Government's liability in para. 1.10 and 1.11 and the conditions of service in the "Application for Calibration" form.

3.5 On completion of the calibration, the customer will be informed regarding the collection/return of the equipment.

4. Hong Kong Laboratory Accreditation Scheme (HOKLAS)

4.1 Laboratories approved or seeking approval under HOKLAS are required to have their measurement standards and measuring equipment regularly calibrated by a competent calibration laboratory which offers traceability to internationally recognised primary standards.

4.2 SCL has been designated by HOKLAS as one of the competent organisations which can provide the necessary traceable calibrations.

4.3 HOKLAS has mutual recognition arrangements with a number of overseas laboratory accreditation schemes. Updated information is available from HKAS webpage (http://www.itc.gov.hk/hkas).

4.4 To encourage the development of more calibration services in Hong Kong, SCL will discontinue any calibration service whenever equivalent HOKLAS accredited services become readily available from other local laboratories.

5. Calibration Services Available

5.1 A list of the calibration services and the current fees are found in the pages following. The fees are subject to change from time to time, without prior notice.

5.2 As it is impractical to list definitively all calibrations for which the SCL has measurement capability, prospective customers with a requirement for calibrations which are not listed are welcome to contact SCL.

5.3 As SCL does not have a shipping section, it will be necessary for the overseas customer to arrange for the delivery of equipment to SCL and for collection after calibration. It is recommended that the customer appoints a transportation agent who can make all the necessary arrangements for customs clearance, insurance, packing and transportation.

SCOPE OF CALIBRATION SERVICES

1. DIRECT CURRENT LABORATORY

(Enquiry Telephone 2829 4832)

1.1 Standard Cells and Electronic Voltage References

1.1.1 The value of electromotive force of a saturated standard cell can be measured with best measurement uncertainty only if the cell is of high quality and is contained in a temperature regulated enclosure.

1.1.2 Cells without temperature control will be calibrated at a nominal ambient temperature of 23 °C.

1.1.3 Electronic voltage reference standards submitted for calibration should have a nominal voltage of 1 V, 1.018 V or 10 V. Additional uncertainty will be added for other values of emf.

		Fee in HK$
1.1.4	Calibration charges	
1.1.4.1	Measurement of emf of a saturated standard cell.	$2890
1.1.4.2	Measurement of emf of each additional standard cell, in the same enclosure.	$950
1.1.4.3	Measurement of emf of an electronic voltage reference standard (at one emf).	$2890
1.1.4.4	Measurement of emf of each additional voltage, from the same reference standard, of same nominal value.	$950

1.2 Standard Resistors

1.2.1 Standard resistors in the range 1 mΩ to 100 MΩ can be measured.

1.2.2 For oil-immersed standard resistors, the best measurement uncertainties will be assigned only to 4-terminal decade-valued standard resistors of high quality, and for measurements being made with the resistors immersed in a constant temperature oil bath at 23 °C. Measurement at oil temperatures other than 23 °C and in the temperature range 18 to 25 °C can also be made with additional uncertainties.

1.2.3 Resistors not suitable for oil immersion or of values above 1 MΩ will normally be measured in air at nominal temperature of 23 °C with increased measurement uncertainty.

1.2.4 Resistors of non-decade values are measured with additional uncertainties.

1.2.5 Calibration of temperature coefficients for oil-immersed standard resistors is also available. Normally, 23 °C is taken as the reference temperature and the temperature coefficients are determined from results of our resistance measurements made at the reference temperature and at 3 other temperatures over the temperature range of 18 to 25 °C, using appropriate curve fitting techniques. The resistance value at the reference temperature will also be reported.

1.2.6 Calibration charges		Fee in HK$
1.2.6.1	Measurement of the resistance of a standard resistor with nominal decade value, in range 1 mΩ to 100 MΩ.	
	(1) at one temperature.	$1910
	(2) for each additional temperature (for resistors suitable for oil-immersion).	$ 680
1.2.6.2	Measurement of the resistance of a standard resistor with nominal non-decade value, in range 1 mΩ to 100 MΩ.	
	(1) at one temperature.	$1920
	(2) for each additional temperature (for resistors suitable for oil- immersion).	$ 680
1.2.6.3	Measurement of temperature coefficients for an oil immersed standard resistor.	$4080
1.2.6.4	Measurement of the resistance for all settings of the first decade of a decade resistance box.	$3170
1.2.6.5	Measurement of the resistance for all settings of each additional decade of the same decade resistance box.	$1060
1.2.6.6	Measurement of the resistance of each resistor of a resistor build-up box (Maximum 12 resistors).	$8470

1.3 High-value Resistors

1.3.1 The Laboratory offers calibration of high-value DC resistors and resistance boxes in the range 100 MΩ to 1 TΩ (1 x 10^{12} Ω). In general, measurements will be made in air at nominal ambient temperature of 23 °C and relative humidity of 45 %. Customers may specify their required test voltage between 100 V and 1 kV.

1.3.2 Measurement uncertainties will vary with test voltages and resistance.

1.3.3 Calibration charges		Fee in HK$
1.3.3.1	Measurement of resistance of a high-value standard resistor in the range 100 MΩ to 1 TΩ at one test voltage.	$2850
1.3.3.2	Measurement of resistance of the same resistor at each additional test voltage.	$ 970
1.3.3.3	Measurement of resistance for all settings of the first decade of a high- value decade resistance box.	$8130
1.3.3.4	Measurement of resistance for all settings of each additional decade of the same resistance box.	$2710

1.4 Current-Carrying Resistors (Current Shunts)

1.4.1 Four-terminal current-carrying standard resistors in the range 0.1 mΩ to 1 Ω can be calibrated. The maximum test current is 100 A at 0.1 mΩ but becomes smaller at higher resistance values. At 1 Ω, it is limited to 1 A.

1.4.2 Resistors suitable for oil immersion will normally be measured in a constant temperature oil bath at 23 °C. Air-cooled resistors will be measured in air at an ambient temperature of 23 °C.

1.4.3 Resistors are usually measured at 50 % of their rated currents. If other current levels are required, customers should specify their particular requirements.

1.4.4 Calibration charges		Fee in HK$
1.4.4.1	Measurement of resistance for a current-carrying resistor at one test current.	$2410
1.4.4.2	Measurement of resistance for the same current- carrying resistor at each additional test current.	$1000

1.5 DC Volt Ratio Boxes

1.5.1 Volt ratio boxes rated up to 1000 V are usually calibrated at rated voltage against the Laboratory's standard.

1.5.2 Calibration charges		Fee in HK$
1.5.2.1	Measurement of the first ratio.	$1920
1.5.2.2	Measurement of each additional ratio on the same box.	$ 450

1.6 DC Voltage Calibrators

1.6.1 DC voltage calibrators with ranges from 10 mV to 1000 V can be calibrated. The basic measurements will include measurement of output voltage at full range settings for each range, and linearity check at 5 voltage levels for one range. Linearity check for other ranges can be offered at extra charge.

1.6.2 Calibration charges		Fee in HK$
1.6.2.1	Calibration of a DC voltage calibrator with not more than 5 ranges.	$3800
1.6.2.2	Measurement at full range setting for each additional range (for calibrators with more than 5 ranges).	$ 430
1.6.2.3	Each additional linearity check.	$1180

1.7 DC Potentiometers

1.7.1 If the potentiometer under test has its own internal voltage reference and power supply, these will be used, unless they are found to be unstable.

1.7.2 Generally, the calibration procedure recommended in the manufacturer's service manual will be followed.

1.7.3 Calibration charges		Fee in HK$
1.7.3.1	Test on potentiometer with a degree of sub-division not exceeding 1 in 200,000.	$ 7610
1.7.3.2	Test on potentiometer with a degree of sub-division exceeding 1 in 200,000 but not exceeding 1 in 2,000,000.	$10160

1.8 DC Voltmeters

1.8.1 The Laboratory offers calibrations for DC voltmeters rated from 100 µV to 1 kV. Single range voltmeters are normally calibrated at cardinal points (maximum 10 test points). For multi-range voltmeters, the basic calibration will include measurements at full ranges and linearity check at 5 voltage levels for one range. Linearity check for other ranges can be offered at extra cost.

1.8.2 Calibration charges		Fee in HK$
1.8.2.1	Calibration of a single range DC voltmeter.	$1920
1.8.2.2	Calibration of a multi- range DC voltmeter with not more than 5 ranges.	$2850
1.8.2.3	Calibration at full range for each additional range (for voltmeters with more than 5 ranges).	$ 330
1.8.2.4	Each additional linearity check.	$ 980

1.9 DC Ammeter

1.9.1 The Laboratory offers calibrations for DC ammeters rated from 10 µA to 100 A.

1.9.2 The DC ammeter will normally be calibrated at full range in each range.

1.9.3 Calibration charges		Fee in HK$
1.9.3.1	Calibration at full range for DC ammeters with not more than 3 ranges.	$1700
1.9.3.2	Calibration at full range for each additional range on the same DC ammeter (for ammeters with more than 3 ranges).	$ 450
1.9.3.3	Calibration at each additional test point of the same range.	$ 450

1.10 DC Current Calibrators

1.10.1 DC current calibrators with ranges from 1 µA to 100 A can be calibrated. The calibration is usually made at full range setting for each range. Calibration at additional test points can be offered at extra charge.

1.10.2 Calibration charges		Fee in HK$
1.10.2.1	Measurement at full range setting for a DC current calibrator with not more than 3 ranges.	$2490
1.10.2.2	Measurement at full range setting for each additional range of the same calibrator.	$ 430
1.10.2.3	Measurement for each additional current setting of the same range.	$ 430

1.11 DC High Voltage Supplies

1.11.1 DC High Voltage Supplies rated up to 30 kV can be calibrated. The basic calibration will include measurement of output high voltages at appropriate settings or values indicated by an output voltmeter (normally not exceeding 5 voltage values).

1.11.2 The output high voltages will be measured by a Laboratory high voltage divider having a total input resistance of 10^9 ohms. Before submitting their equipment for calibration, customers are advised to check whether the output current capability of their supply is sufficient to drive this resistive load. They should check also with the Laboratory whether any special adapters will be required.

1.11.3 Calibration charges		Fee in HK$
1.11.3.1	Calibration of a single range DC High Voltage Supply.	$3780
1.11.3.2	Calibration for each additional range (5 voltage values).	$1920

1.12 DC High-voltage Voltmeter

1.12.1 DC voltmeters with measuring ranges from 1 kV to 30 kV will be calibrated by comparing their readings with the known values of applied high voltages.

1.12.2 Low-voltage voltmeters and detachable high-voltage probes for range extension may be calibrated together as a single high-voltage voltmeter.

1.12.3 Customers may be required to provide appropriate adapters if their equipment cannot be connected directly to the Laboratory's measurement system.

1.12.4 For single-range voltmeters, calibration will be made at cardinal points (maximum 5 points).

1.12.5 For multi-range voltmeters, the basic calibration will include measurements at full range for each range and linearity check on one basic range. Linearity check on additional ranges may be offered at extra cost.

1.12.6 Calibration charges		Fee in HK$
1.12.6.1	Calibration of a single range high voltage voltmeter.	$3800
1.12.6.2	Calibration of a multi- range high-voltage voltmeter with not more than 4 ranges.	$5020
1.12.6.3	Measurement at full range for each additional range.	$ 430
1.12.6.4	Each additional linearity check (maximum 5 voltage values).	$ 970

1.13 DC Resistive High-voltage Dividers

1.13.1 The Laboratory offers calibrations for DC resistive high-voltage dividers rated above 1 kV and with voltage ratios in the range of 10^3 : 1 to 10^5 : 1.

1.13.2 Measurements of voltage ratios are generally made at rated voltage of the divider but the maximum test voltage will be limited to 30 kV.

1.13.3 Measurement uncertainties will depend on the values of the voltage ratios being determined, the magnitude of the applied voltage and stability of the dividers under test. Typical measurement uncertainty is ±60 ppm for dividers of high quality.

1.13.4 Customers may be required to provide appropriate interfacing devices such as adapters if their equipment cannot be connected directly to the Laboratory test system.

1.13.5 Calibration charges		Fee in HK$
1.13.5.1	Measurement of the first voltage ratio at one applied voltage and one specified polarity.	$2850
1.13.5.2	Measurement of each additional voltage ratio on the same divider with the same applied voltage as in 1.13.5.1.	$ 970
1.13.5.3	Measurement of each voltage ratio at an additional test voltage and at one polarity.	$1070
1.13.5.4	Each repeated measurement with opposite polarity.	$ 970

1.14 Insulation Resistance Testers

1.14.1 The Laboratory offers calibration for DC Insulation Resistance Tester with output test voltage not exceeding 1 kV for resistance range from 1 MΩ to 600 GΩ or 5 kV for resistance range 10 MΩ to 600 GΩ.

1.14.2 The tester under test will be calibrated against the high-valued standard resistors of the Laboratory. At each calibration point the indication on the tester will be compared with the value of the applied resistance and the output voltage of the tester will also be measured.

1.14.3 As test leads that are used with a tester may have leakage resistance, it is advisable that the customer submit these leads for test together with the tester.

1.14.4 Calibration charges		Fee in HK$
1.14.4.1	Calibration of a single range DC insulation resistance tester for one output voltage (normally not exceeding 5 test points).	$2150
1.14.4.2	Calibration for each additional range at the same output test voltage (5 test points).	$ 850
1.14.4.3	Calibration for the same range at a different output test voltage (5 test points).	$ 850

2. LOW FREQUENCY LABORATORY

(Enquiry Telephone 2829 4855)

2.1 Digital Multimeters

2.1.1 The Laboratory offers calibrations for Digital Multimeters (DMM's) with 5-1/2 digits or higher resolutions.

2.1.2 The calibration of DMM's will normally include the tests listed hereunder :

(a) DV Voltage (10 mV to 1200 V).

(i) Measurement at full range for all ranges.

(ii) Linearity check for one range (usually the basic range).

(b) AC Voltage (10 mV to 1 kV, 40 Hz to 1 MHz, $<2 \times 10^7$ V-Hz).

Measurement at full range for 3 test frequencies.

(c) DC Current (100 µA to 2 A).

Measurement at full range for all ranges.

(d) AC Current (100 µA to 2 A, 40 Hz to 10 kHz).

Measurement at full range for all ranges for 3 test frequencies.

(e) DC Resistance (1 mΩ to 100 MΩ).

Measurement at full range (decade values) for all ranges.

2.1.3 DMM's up to 7-1/2 digits are normally calibrated against the Laboratory precision DMM's or calibrators and the calibration charges applicable are listed in section 2.1.5.

2.1.4 For DMM's of higher resolutions, or requiring special test specifications or techniques for better measurement uncertainties, calibration charges will be quoted, upon request.

2.1.5 Calibration charges

		Fee in HK$
2.1.5.1	Calibration of two functions of a DMM up to 7-1/2 digits.	$2940
2.1.5.2	Calibration for each additional measurement function up to 7-1/2 digits.	$ 730

2.2 AC-DC Transfer Instruments

2.2.1 AC-DC transfer instruments will be calibrated by comparison with the Laboratory standards, which cover the range 0.25 V to 1000 V and 40 Hz to 1 MHz.

2.2.2 Calibration charges		Fee in HK$
2.2.2.1	AC-DC difference measurement at one frequency/voltage combination.	$2970
2.2.2.2	Measurement at each additional frequency/ voltage combination.	$ 630

2.3 AC Voltage Standards (Fixed Output)

2.3.1 AC voltage standards with fixed output voltages will be calibrated by AC-DC transfer measurements. The calibration will also include measurement of output frequency.

2.3.2 Calibration charges		Fee in HK$
2.3.2.1	Measurement of voltage and frequency of an AC voltage standard with single output.	$2970
2.3.2.2	Measurement of voltage and frequency for each additional output on the same equipment.	$ 990

2.4 AC Voltage Calibrators

2.4.1 The method used for calibrating AC voltage calibrators will depend on the required accuracy and bandwidth of the unit under test.

2.4.2 For highest accuracy, the calibrator will be calibrated using AC-DC transfer technique. In general, measurements will be restricted to the 0.25 V to 1000 V range, and frequencies 40 Hz to 1 MHz.

2.4.3 The calibration of a precision AC voltage calibrator will basically include :

(a) Measurement of output voltage at full range for each range, at one frequency.

(b) Linearity check at 5 voltage levels on one range at the same frequency as in (a).

2.4.4 Additional voltage measurement at other frequency settings as well as frequency accuracy check may be offered at extra charge.

2.4.5 Calibration charges		Fee in HK$
2.4.5.1	Basic calibration of an AC voltage calibrator.	$6220
2.4.5.2	Voltage measurement at each additional frequency/ voltage combination.	$ 630
2.4.5.3	Frequency accuracy check at 6 different frequency settings at one voltage level (normally at 1 V).	$ 990

2.5 AC Voltmeters

2.5.1 Analogue and digital AC voltmeters covering the ranges 1 mV to 1000 V, and 20 Hz to 1 MHz ($<2 \times 10^7$ V-Hz) will normally be calibrated against the Laboratory AC voltage calibrators.

2.5.2 AC voltmeters will normally be calibrated at 5 test voltages for one range to establish the scale linearity. For multi-range voltmeters, additional measurements will be made at full range for all the other ranges.

2.5.3 Linearity check for other ranges may be offered upon request at additional charge.

2.5.4 For precision AC voltmeters requiring calibration at very high accuracy, AC-DC transfer technique will be used.

2.5.5 Calibration charges		Fee in HK$
2.5.5.1	Calibration of single range on AC voltmeter, at one frequency.	$1560
2.5.5.2	Calibration of each additional range at full range on the same AC voltmeter, at one frequency.	$ 170
2.5.5.3	Additional linearity check at one frequency, per range.	$ 780
2.5.5.4	Calibration at each additional frequency :	
	(i) First range (5 test voltages)	$ 780
	(ii) Each additional range (at full range).	$ 170

Calibration Charges		Fee in HK$
2.5.5.5	Calibration of precision AC voltmeter at one frequency/ voltage combination by AC-DC transfer.	$2470
2.5.5.6	Calibration at each additional frequency/ voltage combination by AC-DC transfer, for the same equipment.	$ 610

2.6 AC Ammeters

2.6.1 The Laboratory offers calibrations for ammeters rated from 100 μA to 20 A (up to 20 kHz) and from 100 μA to 100 A (45 Hz to 60 Hz) using the Laboratory current calibrators.

2.6.2 The AC ammeter will normally be calibrated at 5 test currents for one range to establish the scale linearity. For multi-range ammeters, additional measurements will be made at full range for all the other ranges.

2.6.3 Linearity check for other ranges may be offered upon request.

2.6.4 Calibration charges		Fee in HK$
2.6.4.1	Calibration of single range on AC ammeter, at one frequency.	$1430
2.6.4.2	Calibration of each additional range at full range on the same AC ammeter, at one frequency.	$ 160
2.6.4.3	Additional linearity check at one frequency, per range.	$ 700
2.6.4.4	Calibration at each additional frequency :	
	(i) First range (5 test currents).	$ 700
	(ii) Each additional range(at full range).	$ 160

2.7 AC Current Calibrators

2.7.1 The Laboratory offers calibrations for AC current calibrators or transconductance amplifiers with output in the range 100 μA to 20 A and 20 Hz to 20 kHz. At power frequencies (45 Hz to 60 Hz), the measuring range can be extended to 100 A. However, the calibrator under test must be capable of driving inductive loads as precision current transformers will be used for the measurements in this extended range.

2.7.2 Calibration charges			Fee in HK$
2.7.2.1	Calibration for the first current value.		
	(i)	at one frequency.	$3090
	(ii)	at each additional frequency.	$ 520
2.7.2.2	Calibration for each additional current value.		
	(i)	at one frequency.	$ 680
	(ii)	at each additional frequency.	$ 520

2.8 Wattmeters

2.8.1 The Laboratory offers calibration for single-phase wattmeters at fixed frequencies of 50 Hz, 60 Hz or 400 Hz, and in the power factor range of unity to 0.5 leading or lagging.

2.8.2 Wattmeters will be calibrated by direct comparison method against the Laboratory standard wattmeter with phantom load. The theoretical power measuring range is 37 W to 6 kW and the maximum test voltage and current are respectively 300 V and 20 A.

2.8.3 Basic calibration of a wattmeter will include tests at rated voltage and frequency with 5 different current settings on the current range (unity power factor). For multi-range wattmeters, additional measurements will be made for all combinations of rated voltage and current ranges.

2.8.4 Calibration charges		Fee in HK$
2.8.4.1	Calibration of a wattmeter at rated voltage with 5 different current settings on one current range (at one frequency and one power factor).	$2400
2.8.4.2	Additional measurement for each combination of rated voltage and current ranges for multi-range wattmeters (same frequency and power factor as in 2.8.4.1).	$ 450
2.8.4.3	Additional service as in 2.8.4.1 but at a different frequency or power factor.	$1190
2.8.4.4	Additional service as in 2.8.4.2 but at the same frequency or power factor as for 2.8.4.3.	$ 450

2.9 Power Factor Meters

2.9.1 The Laboratory can provide calibration for 50 or 60 Hz single-phase power factor meters with measuring range from zero to unity, leading or lagging.

2.9.2 Calibration will be made by applying appropriate sinusoidal voltage and current signals with known phase relationship to the meter under test. The ranges of test voltages and currents are 25 V to 250 V and 50 mA to 100 A respectively.

2.9.3 Calibration charges		Fee in HK$
2.9.3.1	Calibration of power factor measuring function for one combination of frequency, voltage and current.	$2470
2.9.3.2	Calibration of power factor measuring function for each additional combination of frequency, voltage and current.	$ 990

2.10 Phasemeters

2.10.1 The Laboratory offers calibration for phasemeters in frequency range 1 Hz to 100 kHz.

2.10.2 The phasemeters will be calibrated by applying two digitally synthesised low distortion sine waves generated by the Laboratory's phase angle standard. Signal levels range from 100 mV to 100 V rms.

2.10.3 The basic calibration for a phasemeter include checking of phase angle measurement accuracy at equal signal levels for 4 different frequencies.

2.10.4 Calibration charges		Fee in HK$
2.10.4.1	Basic calibration for a phasemeter.	$2970
2.10.4.2	Each additional test point.	$ 100

2.11 Withstanding Voltage Testers

2.11.1 The Laboratory offers calibration for withstanding voltage testers with sinusoidal output voltages (50 Hz) not exceeding 11 kV (rms value). The calibration will normally include measurement of output voltages and test for leak current detection accuracy. Customers may be required to provide appropriate loading resistors for the leak current test.

2.11.2 For calibration of testers having additional functions, or higher output voltages, or more than the number of ranges specified in section 2.11.3 below, the additional charges will be quoted upon request.

2.11.3 Calibration charges		Fee in HK$
2.11.3.1	Measurement of output voltages from a Withstanding Voltage Tester (normally for not more than 2 output ranges).	$2260
2.11.3.2	Measurement of output voltages from the same equipment for each additional output range.	$ 570
2.11.3.3	Leak current detection accuracy test for the same equipment (normally for not more than 7 leak current settings).	$2260
2.11.3.4	Leak current detection accuracy test for each additional leak current setting.	$ 180

2.12 Capacitors

2.12.1 The Laboratory offers calibration of 2 and 3 terminal capacitors in the range from 10 pF to 1.11 µF, including measurement of capacitance and dissipation factor.

2.12.2 Tests are normally made at a nominal ambient temperature of 23 °C; and unless otherwise specified the test frequency will be 1 kHz. Tests at other frequencies in the range from 50 Hz to 10 kHz can be offered but with increased measurement uncertainty.

2.12.3 Calibration charges		Fee in HK$
2.12.3.1	Measurement of the capacitance of a standard capacitor, at one frequency.	$1970
2.12.3.2	Measurement of the capacitance at each additional frequency for the same capacitor.	$ 990
2.12.3.3	Measurement of the capacitance and dissipation factor of a standard capacitor, at one frequency.	$2420
2.12.3.4	Measurement of the capacitance for all settings of the first decade of a decade capacitance box, at one frequency.	$2970

Calibration charges		Fee in HK$
2.12.3.5	Measurement of the capacitance for all settings of each additional decade of the same decade capacitance box, at one frequency.	$ 990

2.13 Standard Inductors

2.13.1 The Laboratory offers calibration of standard inductors in the range from 100 µH to 1 H.

2.13.2 Measurements are normally made at a nominal ambient temperature of 23 °C; and unless otherwise specified, the test frequency will be 1 kHz. (Tests at 400 Hz and 10 kHz can be offered upon request.)

2.13.3 The inductor will be calibrated as a 2-terminal device and the series equivalent inductance of the device will be reported.

2.13.4 Calibration charges		Fee in HK$
2.13.4.1	Measurement of the self- inductance of a standard inductor, at one frequency.	$1970
2.13.4.2	Measurement of the self- inductance at each additional frequency for the same inductor.	$ 990

2.14 LCR Meters

2.14.1 There are many methods for measuring impedance and commercial LCR meters may have very different working principles. It is more advisable that customers submit their impedance standards for calibration, which in turn can be used to perform in-house checking of their LCR meters. However, the Laboratory may offer performance checks for LCR meters using impedance standards.

2.14.2 The tests will normally be made at 1 kHz and will be restricted to decade values in the following ranges :

Resistance : 1 Ω to 10 kΩ (2- or 4-terminal)

Capacitance : 10 pF to 1 µF (2- or 3-terminal)

Inductance : 100 µH to 1 H (2-terminal)

2.14.3 Customers may be required to submit compatible test fixture and/or test leads for the tests.

2.14.4 Calibration charges		Fee in HK$
2.14.4.1	Performance checks on a LCR Meter at 1 kHz.	$4200

2.15 Inductive Voltage Dividers

2.15.1 Inductive voltage dividers (IVD's) will be calibrated by comparison with the Laboratory's 8-dial IVD, normally at specific frequencies of 400 Hz, 1 kHz and 10 kHz with an input test voltage of 25 V. The calibration normally involve measurement of voltage ratio (magnitude) of the output voltage related to the input voltage of the IVD.

2.15.2 The basic calibration for a single decade IVD will include measurement of voltage ratio for all output settings of the IVD at one test frequency.

2.15.3 The basic calibration for a multi-decade IVD will include measurement of voltage ratio at one frequency for all separate settings of the first and second dials of the IVD. Additionally, measurement will be made with all dials in use to realise the ratios which are multiples of 1/11 to cover the performance of all dials.

2.15.4 Calibration charges		Fee in HK$
2.15.4.1	Calibration of a single- decade IVD at one frequency.	$2970
2.15.4.2	Calibration of a multi- decade IVD at one frequency.	$5940
2.15.4.3	Calibration at each additional test point.	$ 240

2.16 AC High-voltage Voltmeter (Enquiry Telephone 2829 4832)

2.16.1 High-voltage voltmeters with measuring ranges from 1 kV to 11 kV, 50 Hz can be calibrated.

2.16.2 A low-voltage voltmeter associated with detachable high-voltage probe for range extension may be calibrated together as a single high-voltage voltmeter.

2.16.3 For single-range voltmeters, calibration will be made at cardinal points (normally not exceeding 5 points).

2.16.4 For multi-range voltmeters, the basic calibration will include measurements

at full range for each range and linearity check on one range.

		Fee in HK$
2.16.5	Calibration charges	
2.16.5.1	Calibration of a single range AC high voltage voltmeter.	$3800
2.16.5.2	Calibration of a multi-range AC high voltage voltmeter with not more than 2 ranges.	$4210
2.16.5.3	Measurement at full range for each additional range of a multi-range high voltage voltmeter.	$ 430

3. RADIO FREQUENCY LABORATORY

(Enquiry Telephone 2829 4850)

3.1 General

The RF Laboratory can provide calibrations for RF, time and frequency equipment up to 18 GHz. In general, measurements are available to equipment fitted with coaxial connectors, and 50 Ω nominal characteristic impedance. Limited calibration service can also be offered for equipment with 75 Ω nominal characteristic impedance.

3.2 Time and Frequency

3.2.1 The Laboratory offers calibration service for frequency standards and frequency counters with specified accuracy of better than 1 part in 10^6.

3.2.2 The frequency range covers 1 Hz to 18 GHz.

3.2.3 The calibration of a frequency (time interval or period) counter will basically include time base calibration, and frequency (time interval or period) measurement accuracy check at 6 different test points. Calibration at additional test points can be arranged on demand.

3.2.4 Calibration charges

		Fee in HK$
3.2.4.1	Calibration of frequency/ time base standard.	$3490
3.2.4.2	Calibration of time scale standard.	$3490
3.2.4.3	Calibration of frequency/ time interval/period counter.	$2460
3.2.4.4	Additional measurement of frequency/time interval/period per test point.	$ 110
3.2.4.5	Calibration of frequency relation of a pair of input/output ports.	$1360

3.3 RF Power Meters

3.3.1 The Laboratory can provide calibrations for RF power meters in the range 0.1 pW to 100 mW for frequency range from 100 Hz to 18 GHz.

3.3.2 The calibration of a power meter normally includes :

(a) Measurement at one frequency for selected levels (normally at 20 dB step); and

(b) Measurement at one power level (normally 10 mW) for a specified number of different frequencies. The number of frequencies tested will determine the calibration fee.

3.3.3 Calibration charges		Fee in HK$
3.3.3.1 Calibration of RF power meter		
	(i) 6 test frequencies.	$3560
	(ii) 12 test frequencies.	$4760
	(iii) 18 test frequencies.	$5930
3.3.3.2 Calibration at each additional frequency/power level combination.		$ 480

3.4 RF Millivoltmeter

3.4.1 The Laboratory can provide calibrations for RF millivoltmeters in the range 2.2 μV to 2.2 V for frequency from 100 Hz to 1 GHz.

3.4.2 The calibration will normally include :

(a) Measurement at one frequency for selected levels (normally at 20 dB step); and

(b) Measurement at one voltage level (normally 1 V) for a specified number of different frequencies. The number of frequencies tested will determine the calibration fee.

3.4.3 Calibration charges		Fee in HK$
3.4.3.1 Calibration of RF millivoltmeter		
	(i) 6 test frequencies.	$2970
	(ii) 12 test frequencies.	$3950
	(iii) 18 test frequencies.	$4950
3.4.3.2 Calibration at each additional frequency/voltage level combination.		$ 400

3.4.4 RF voltmeter with frequency limit beyond 1 GHz will be charged as RF power meters in Section 3.3.

3.5 Signal Generators

3.5.1 The basic calibration of a RF signal generator normally includes tests on output level accuracy, level flatness, and frequency accuracy.

3.5.2 Internal modulation (AM and FM) check, and time base calibration can be provided at extra charge.

3.5.3 Calibration charges		Fee in HK$
3.5.3.1	Calibration of a signal generator with frequency range extending to	
	(i) 2 GHz.	$3320
	(ii) 4 GHz.	$4410
	(iii) 8 GHz.	$5510
	(iv) 12 GHz.	$6590
	(v) 18 GHz.	$7730
3.5.3.2	Additional time base calibration on the same unit.	$1110
3.5.3.3	Additional internal AM/FM modulation accuracy check on the same unit (maximum carrier frequency limited to1.3 GHz).	$ 740

3.6 Spectrum Analysers

3.6.1 The calibration of a spectrum analyser normally includes checks on frequency accuracy, level flatness, level linearity, input attenuation and calibration reference output.

3.6.2 Calibration charges		Fee in HK$
Calibration of a spectrum analyser with frequency range extending to		
(i)	500 MHz.	$ 6100
(ii)	2 GHz.	$ 7350
(iii)	8 GHz.	$ 8620
(iv)	12 GHz.	$ 9780
(v)	18 GHz.	$10990

3.7 Modulation Meters

3.7.1 The Laboratory has measurement capability for frequency and amplitude modulations, for carrier frequencies in the range 150 kHz to 1.3 GHz.

3.7.2 Calibration charges — Fee in HK$

Calibration of modulation — See table below

No. of test points	Modulation	
	Frequency	Amplitude
4	$1440	$ 990
Each additional point	$130	$110

3.8 Oscilloscopes

3.8.1 The Laboratory can provide calibrations for oscilloscopes with time base accuracy of better than 1.2% and/or vertical deflection accuracy of better than 3.2%, up to 2 input channels for bandwidth up to 1 GHz real time.

3.8.2 For plug-in type oscilloscopes, the combined unit of mainframe and plug-in units will be calibrated as a composite unit.

3.8.3 The calibration of an oscilloscope normally includes :

(a) Tests on horizontal sweep.

(b) Tests on vertical deflection.

(c) Measurement of upper-3dB bandwidth.

3.8.4 Calibration charges		Fee in HK$
3.8.4.1	Calibration of an oscilloscope with 2 input channels for frequency range extending to:	
	(i) 100 MHz.	$2970
	(ii) 500 MHz.	$3960
	(iii) 1 GHz.	$4950
3.8.4.2	Calibration for each additional input channel of the same unit.	$ 840

3.9 Oscilloscope Calibrators

3.9.1 The Laboratory can provide calibrations for oscilloscope calibrators. The calibration normally includes checks on amplitude output in the range 40 μV to 100 V and time mark output in the range 0.5 ns to 5 s.

3.9.2 Calibration charges		Fee in HK$
3.9.2.1	Calibration of an oscilloscope calibrator for amplitude and time mark outputs.	$4500
3.9.2.2	Calibration of an oscilloscope calibrator for amplitude output only.	$2990
3.9.2.3	Calibration of an oscilloscope calibrator for time mark output only.	$2990

3.10 Fixed and Step Attenuators

3.10.1 The Laboratory offers calibration service for coaxial fixed and step attenuators. The frequency range covers 300 kHz to 18 GHz and attenuation range of 0 to 70 dB.

3.10.2 Calibration charges		Fee in HK$
3.10.2.1	Calibration of fixed attenuator at 6 frequencies.	$1970
3.10.2.2	Calibration of step attenuator for a combination of 6 frequency/attenuation test points.	$1970
3.10.2.3	Calibration at each additional frequency/attenuation combination.	$ 250

3.11 Electronic Timer

3.11.1 The Laboratory offers calibration service for electronic timers with time base output or accessible electronic start/stop trigger. The calibration of electronic timer normally includes time base measurement (if available) and 6 time interval measurements.

	Calibration charges	Fee in HK$
3.11.2.1	Calibration of electronic timer.	$2970
3.11.2.2	Additional measurement of each time interval.	$ 290

3.12 Watch/Stop Watch

3.12.1 The Laboratory offers calibration service for watches/stop watches with internal crystal and step motor. The calibration of watches/stop watches includes the measurement of its relative frequency accuracy.

	Calibration charges	Fee in HK$
3.12.2	Calibration of watch/stop watches.	$1360

4. TEMPERATURE LABORATORY

(Enquiry Telephone 2829 4842)

4.1 General

4.1.1 The SI unit of the fundamental physical quantity "temperature", or more precisely "thermodynamic temperature", is the kelvin, defined as the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

Because of the way earlier temperature scales were defined, it remains common practice to express a temperature in terms of its difference from 273.15 K, the ice point. A thermodynamic temperature, T, expressed in this way is known as Celsius temperature, symbol t, defined by :

t (in °C) = T (in K) - 273.15

4.1.2 The precise measurement of thermodynamic temperatures, for example with a gas thermometer, is very difficult. Practical temperature scales were therefore introduced to make use of instruments such as platinum resistance thermometers which are much easier to use and give much higher precision measurements.

4.1.3 The first International Temperature Scale was adopted in 1927, revised in 1948 as IPTS-48, revised again in 1968 as IPTS-68, and again more recently in 1990 as ITS-90. Officially SCL adopted the ITS-90 from 1 January 1990.

4.1.4 The Laboratory realises the ITS-90 by maintaining the following fixed point standards at :

(1) Triple point of argon (-189.3442 °C).

(2) Triple point of mercury (-38.8344 °C).

(3) Triple point of water (0.0100 °C).

(4) Melting point of gallium (29.7646 °C).

(5) Freezing point of indium (156.5985 °C).

(6) Freezing point of tin (231.928 °C).

(7) Freezing point of zinc (419.527 °C).

(8) Freezing point of aluminium (660.323 °C).

(9) Freezing point of silver (961.78 °C).

In addition to the above fixed point primary temperature standards, the Laboratory possesses standard platinum resistance thermometers and standard type R thermocouples which are calibrated directly in ITS-90.

4.1.5 Apart from the above fixed points, calibration service covers the full range from -80 °C to 1100 °C, and caters for almost all practical thermometers such as liquid-in-glass thermometers, digital thermometers, thermocouple or resistance thermometers, etc.

4.2 Liquid-in-glass Thermometers

4.2.1 A thermometer submitted for test is examined for structural defects, errors in figuring and dividing, trapped gas or impurities, and excessive strain before calibration.

4.2.2 After examination, the thermometer is allowed to be stabilised in a standard condition. Calibration is usually commenced at the lowest test temperature and the chosen test points are calibrated sequentially. At each test point, readings are taken and compared with the Laboratory standards, in constant temperature baths.

4.2.3 Calibration charges		Fee in HK$
4.2.3.1	Calibration at one temperature.	$1970
4.2.3.2	Calibration at each additional temperature.	$ 460
4.2.3.3	Additional charge, if any of the above test temperatures exceed 230 °C.	$ 980

4.3 Platinum Resistance Thermometers

4.3.1 Standard platinum resistance thermometers satisfying the requirements of the ITS-90 may be calibrated at the appropriate fixed-points. For such calibrations it is necessary that the sensor element be mounted and sealed in a glass sheath so that the distance from the tip of the element to the bottom of the head of the thermometer is at least 450 mm, and the diameter of the glass sheath should not be greater than 8 mm.

4.3.2 Industrial platinum resistance thermometers designed for use as lower grade standards than those satisfying the requirements of the ITS-90 are calibrated by comparison with Laboratory standards.

4.3.3 The resistance ratios of the platinum resistance thermometer at the measuring temperatures will be determined and fitted to a polynomial. The coefficients of the polynomial will be reported.

4.3.4 Calibration charges		Fee in HK$
4.3.4.1	Calibration at one temperature.	$2880
4.3.4.2	Calibration at each additional temperature.	$ 690
4.3.4.3	Additional charge, if any of the above test temperatures exceed 230 °C.	$ 980
4.3.4.4	Calibration at triple point of argon.	$5930
4.3.4.5	Calibration at triple point of mercury.	$2880
4.3.4.6	Calibration at triple point of water.	$2880
4.3.4.7	Calibration at melting point of gallium.	$2880
4.3.4.8	Calibration at freezing point of indium.	$5930
4.3.4.9	Calibration at freezing point of tin.	$5930
4.3.4.10	Calibration at freezing point of zinc.	$5930
4.3.4.11	Calibration of freezing point of aluminium.	$7420
4.3.4.12	Calibration at freezing point of silver.	$7420

4.4 Digital Thermometers

4.4.1 Digital thermometers will be calibrated by immersing their sensor probes in constant temperature baths or furnaces and comparing with Laboratory standards.

4.4.2 If the diameter of the probe exceeds 8 mm, or if the probe is bent or of irregular shape, or if the length of the probe (excluding handle) is less than 40 cm, there could be difficulty in providing the calibration. In such cases, please discuss with SCL the feasibility of the calibration.

4.4.3 Battery operated units must be submitted with batteries which are in good working condition, and fully charged. It is advisable to submit the battery charger or AC/DC adapter as well.

4.4.4 Calibration charges		Fee in HK$
4.4.4.1	Calibration at one temperature.	$2240
4.4.4.2	Calibration at each additional temperature.	$ 540
4.4.4.3	Additional charge, if any of the above test temperatures exceed 230 °C.	$ 980
4.4.4.4	Calibration for an additional probe, for each temperature (temperature same as per 4.4.4.1 and 4.4.4.2).	$ 200

4.5 Thermocouples

4.5.1 Thermocouples will be calibrated by comparison with Laboratory standards, in constant temperature baths or furnaces. The reference junction will be kept at 0 °C.

4.5.2 The inhomogeneity of the thermocouple wire will normally be evaluated to assess its effect on the calibration uncertainty.

4.5.3 The thermal emfs of the thermocouple at the measuring temperatures will be determined and fitted to a polynomial. The coefficients of the polynomial will be reported.

4.5.4 For thermocouples bearing serial numbers or markings for identification, certificates of calibration will be issued. Otherwise, calibration reports will be issued instead.

4.5.5 Thermocouples submitted should be no less than 1 m in overall length.

4.5.6 Calibration charges		Fee in HK$
4.5.6.1	Calibration at one temperature.	$2420
4.5.6.2	Calibration at each additional temperature.	$ 570
4.5.6.3	Additional charge, if any of the above temperatures exceed 230 °C.	$ 980

4.6 Temperature Loggers/Recorders

4.6.1 Temperature loggers/recorders with multiple input channels will generally be calibrated as follows :

(i) Calibration at specified temperatures on one channel.

(ii) Verification of all input channels at one test temperature or equivalent emf.

4.6.2 Calibration charges		Fee in HK$
4.6.2.1	Calibration at one temperature on one channel.	$2240
4.6.2.2	Calibration at each additional temperature on the same channel.	$ 540
4.6.2.3	Verification of up to 20 input channels at one temperature. (Additional charges are applicable for units with more than 20 input channels).	$ 530
4.6.2.4	Additional charge, if any of the above temperatures exceed 230 °C.	$ 980
4.6.2.5	Calibration for an additional probe, for each temperature (temperature same as per 4.6.2.1 and 4.6.2.2).	$ 200

4.7 Bimetal/Dial Thermometers

4.7.1 Bimetal/dial thermometers will be calibrated by comparison with Laboratory standards in constant temperature baths or furnaces.

4.7.2 Calibration charges		Fee in HK$
4.7.2.1	Calibration at one temperature.	$2090
4.7.2.2	Calibration at each additional temperature.	$ 520
4.7.2.3	Additional charge, if any of the above test temperatures exceed 230 °C.	$ 980

4.8 Beckmann Thermometers

4.8.1 Beckmann thermometers are designed to measure small temperature differences. Hence the calibration of a Beckmann thermometer refers to comparing the true temperature differences obtained from the Laboratory's standard thermometers against the observed temperature differences indicated by scale readings of the unit under test. The measurements are carried out relative to a fixed base temperature.

4.8.2 Calibration charges		Fee in HK$
4.8.2.1	Calibration at one temperature.	$2420
4.8.2.2	Calibration at each additional temperature.	$ 570
4.8.2.3	Additional charge, if any of the above temperatures exceed 230 °C.	$ 980

4.9 Other Services

4.9.1 Fixed point cells such as

(a) Triple point of argon
(b) Triple point of mercury
(c) Triple point of water
(d) Melting point of gallium
(e) Freezing point of indium
(f) Freezing point of tin
(g) Freezing point of zinc
(h) Freezing point of aluminium
(i) Freezing point of silver

can be calibrated by comparison against SCL's fixed point cells. Quotation can be provided upon request.

4.9.2 Furnaces, thermo-switches, thermocouple calibrators, and other types of thermal sensing or measuring devices may also be calibrated. Quotations can be provided upon receipt of details of the calibration requirements.

5. MECHANICAL METROLOGY LABORATORY

(Enquiry Telephone 2829 4805)

5.1 Dimensional Measurement

5.1.1 The base unit of length in the International Metric System (SI) is the metre which, since 1983, is defined by the General Conference of Weights and Measures as "The length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second". In accordance with the recommendation for the practical realisation of the above definition of the International Committee of Weights and Measures, the Laboratory maintains the metre through the wavelength of the 633 nm radiation from an iodine-stabilised helium-neon laser. This wavelength, λ, is derived from the internationally agreed value for the frequency, ν, of the radiation and the speed of light, c (299 792 458 m/s), by the relation $\lambda = c/\nu$.

5.1.2 Laser interferometer systems are now in widespread use in engineering metrology for the measurement of length, displacement and other dimensional quantities. Usually the measuring values of these systems are based on the wavelengths of the incorporated laser sources. Hence, in order to ensure that the high potential accuracy of these instruments is achieved, the values of their wavelengths in vacuum must be known.

5.1.3 The Laboratory can provide calibration service for the measurement of the wavelength of any laser having a nominal wavelength of 633 nm. Calibration is performed by comparing the wavelength of the laser under test with the wavelength of the standard iodine-stabilised helium-neon laser of the Laboratory.

5.1.4 The Laboratory can also provide calibration services for gauges, measuring instruments and machines used to check and/or measure length and geometrical parameters (e.g. flatness, parallelism, straightness and squareness). The Laboratory also provides services for measuring dimensions, geometrical parameters, surface texture, and roundness of most engineering components and artefacts.

5.1.5 The measured values will be quoted at 20 °C in accordance with international convention.

5.1.6 Calibration charges

	Description		Fee in HK$
5.1.6.1	Angle gauge, one piece		$1500
5.1.6.2	Per additional piece		$740
5.1.6.3	Angle plate, box angle plate		$2970
5.1.6.4	Bench centre		$2970
5.1.6.5	Bench micrometer		$3960
5.1.6.6	Bevel protractor		$2970
5.1.6.7	Calliper checker	(up to 300 mm)	$6850
5.1.6.8		(up to 600 mm)	$8550
5.1.6.9	Check master	(up to 300 mm)	$7700
5.1.6.10		(up to 600 mm)	$9410
5.1.6.11		(up to 1000 mm)	$13680
5.1.6.12	Clinometer, single face		$2970
5.1.6.13	Per additional face		$740
5.1.6.14	Comparator (external)		$2970
5.1.6.15	Cylindrical square		$2970
5.1.6.16	Dial gauge, dial test indicator		$2650
5.1.6.17	Electronic indicating level		$2970
5.1.6.18	Engineers' steel rule (up to 5 intervals)		$2970
5.1.6.19	Per additional interval		$250
5.1.6.20	Feeler gauge (up to 10 blades)		$1600
5.1.6.21	Per additional blade		$150
5.1.6.22	Gauge block (up to 5 pieces)		$1910
5.1.6.23	Per additional piece		$410
5.1.6.24	Gauge block accessories		$5210
5.1.6.25	Height setting micrometer		$7910
5.1.6.26	Inclinable table		$4210

	Description	Fee in HK$
5.1.6.27	Laser wavelength	$5100
5.1.6.28	Length bar accessories	$5210
5.1.6.29	Measuring microscope	Upon Request
5.1.6.30	Micrometer head	$2100
5.1.6.31	Micrometer setting rod	$1500
5.1.6.32	Per additional piece	$740
5.1.6.33	Optical dividing head	$8650
5.1.6.34	Optical flat, per working face	$1500
5.1.6.35	Optical parallels, per set of 5	$4210
5.1.6.36	Optical projector	Upon Request
5.1.6.37	Parallels, per pair	$2970
5.1.6.38	Pin gauge (up to 10 pieces)	$1600
5.1.6.39	Per additional piece	$170
5.1.6.40	Plain gap gauge	$2170
5.1.6.41	Plain plug gauge, cylindrical setting standard, gear measuring cylinder and roller	$2170
5.1.6.42	Polygon (up to 4 sides)	$2170
5.1.6.43	Per additional side	$540
5.1.6.44	Precision line scale (up to 5 intervals)	$2970
5.1.6.45	Per additional interval	$200
5.1.6.46	Ring gauge	$2190
5.1.6.47	Rotary table	$8650
5.1.6.48	Rotary and inclinable table	$11140
5.1.6.49	Sine bar (table)	$2970
5.1.6.50	Sine centre	$2970
5.1.6.51	Sine table, compound	$4950

	Description		Fee in HK$
5.1.6.52	Spirit level		$2590
5.1.6.53	Square, Engineers' try		$2370
5.1.6.54	Squareness tester		$4850
5.1.6.55	Steel ball (up to 12 balls)		$1970
5.1.6.56	Per additional ball		$170
5.1.6.57	Straightedge	(up to 500 mm)	$2970
5.1.6.58		(over 500 mm)	$5920
5.1.6.59	Straightedge	(toolmakers') (up to 500 mm)	$2100
5.1.6.60		(over 500 mm)	$4210
5.1.6.61	Surface plate		$7030
5.1.6.62	Surface texture standard		$1600
5.1.6.63	Per additional sample		$850
5.1.6.64	Toolmakers' flat		$1970
5.1.6.65	Vee block (double vee), per pair		$3960
5.1.6.66	Vee block (single vee), per pair		$2970
5.1.6.67	Vernier height gauge		$2970
5.1.6.68	Vernier depth gauge		$2100

5.2 **Mass** (Enquiry Telephone 2829 4835)

5.2.1 The unit of mass is the kilogram and is defined as the mass of the International Prototype Kilogram maintained at the International Bureau of Weights and Measures (BIPM) in France. A copy of the Prototype, no. 75, being of the same form and material, is being kept by this Laboratory as the reference standard of mass for Hong Kong and for the dissemination of the unit of mass.

5.2.2 The Laboratory can provide calibration services for standard weights of class E_2 and lower in the range from 1 mg to 10 kg, and standard weights of class F_1 and lower from 20 kg to 50 kg. The classification of weights depends on their maximum permissible errors (refer to the following table), shape, material, construction and surface finish, as described in the International Recommendation R111 - (Weights of classes E_1, E_2, F_1, F_2, M_1, M_2, M_3) of the International Organisation of Legal Metrology (OIML).

Nominal Values of Mass	Class E_2 (± mg)	Class F_1 (± mg)	Class F_2 (± mg)	Class M_1 (± mg)	Class M_2 (± mg)	Class M_3 (± mg)
50 kg	75	250	750	2 500	7 500	25 000
20 kg	30	100	300	1 000	3 000	10 000
10 kg	15	50	150	500	1 500	5 000
5 kg	7.5	25	75	250	750	2 500
2 kg	3.0	10	30	100	300	1 000
1 kg	1.5	5	15	50	150	500
500 g	0.75	2.5	7.5	25	75	250
200 g	0.30	1.0	3.0	10	30	100
100 g	0.15	0.5	1.5	5	15	50
50 g	0.10	0.30	1.0	3.0	10	30
20 g	0.080	0.25	0.8	2.5	8	25
10 g	0.060	0.20	0.6	2.0	6	20
5 g	0.050	0.15	0.5	1.5	5	15
2 g	0.040	0.12	0.4	1.2	4	12
1 g	0.030	0.10	0.3	1.0	3	10
500 mg	0.025	0.08	0.25	0.8	2.5	-
200 mg	0.020	0.06	0.20	0.6	2.0	-
100 mg	0.015	0.05	0.15	0.5	1.5	-
50 mg	0.012	0.04	0.12	0.4	-	-
20 mg	0.010	0.03	0.10	0.3	-	-
10 mg	0.008	0.025	0.08	0.25	-	-
5 mg	0.006	0.020	0.06	0.20	-	-
2 mg	0.006	0.020	0.06	0.20	-	-
1 mg	0.006	0.020	0.06	0.20	-	-

5.2.3 The submitted weights should be in a clean condition and housed in a suitable container or containers.

5.2.4 During calibration test weights are compared with appropriate standards. As weights of higher class require use of standards of higher accuracy and more elaborate calibration procedures, calibration charge will be higher. The customers are therefore urged to apply for calibration accuracy appropriate to their usages (see following paragraph for reference) and specifications of their weights. For example, owing to their brittle property and inferior resistance to wear and corrosion, cast iron weights will only be used as weights of class M_1 and lower.

5.2.5 For calibration of weighing machines, normally the uncertainties of the weights used will be less than the resolution of the machine to be calibrated. The following table serves as a general guideline:

Recommended lowest class of weights required for calibration of weighing machines

	Resolution of weighing machine							
	100 g	10 g	1 g	100 mg	10 mg	1 mg	0.1 mg	0.01 mg or less
Capacity								
Up to 200 g				M_1	M_1	F_2	F_1	E_2
200 g to 1 kg			M_1	M_1	F_2	F_1/E_2	E_2	E_2
1 kg to 30 kg	M_2	M_2	M_1	F_2	E_2	E_2	E_2	
30 kg to 100 kg	M_2	M_1	F_2	F_1	E_2			
Above 100 kg	M_2	M_1/F_2	F_1	E_2				

5.2.6 The measured value for the test weight will be the mass of a hypothetical weight of density 8 000 kg/m^3 which, at 20 °C and in air of density 1.2 kg/m^3, would balance the test weight. The basis is taken by convention and accords with OIML No. 33.

5.2.7 The calibration uncertainty quoted will normally relate to the class of the submitted weight, such that the uncertainties for class E_2 weights and weights of class F_1 or lower will be about 1/3 and 1/5 of the prescribed permissible maximum errors respectively.

5.2.8 Calibration charges		Fee in HK$
5.2.8.1	Class E_2 standard weight, per piece.	$1680
5.2.8.2	Class F_1 standard weight, per piece.	$ 660
5.2.8.3	Class F_2 (or below) standard weight, per piece.	$ 430
5.2.8.4	Minimum charge per issue of certificate/report.	$1020

5.3 **Volume** (Enquiry Telephone 2829 4835)

5.3.1 The Laboratory determines the contained volume (capacity) or the delivered volume of a vessel. The contained volume is the volume of water required to fill the vessel at 20 °C, whilst the delivered volume is the volume of water which may be poured from the vessel at 20 °C under specified conditions (e.g. with a fixed drainage time of 30 seconds after cessation of main flow). The delivered volume is always less than the contained volume, due to the film of liquid left on the walls of the vessel after delivery. The difference between the contained and delivered volume for glassware may be of the order of 0.1% of the capacity for a 1 L flask increasing to 0.25% for a 50 mL flask, when using water.

5.3.2 There are two methods employed by this Laboratory for volumetric determination. The gravimetric method determines the mass of water either contained or delivered from a test measure. From the measured mass, the volume can be determined with knowledge of water density and corrections for air buoyancy and thermal expansion of the vessel. The volumetric method requires a standard (calibrated) volumetric measure. The volume of the test volumetric vessel is determined from the number of "dumps" of the standard measure required to fill the test measure. Normally gravimetric method will be used for volumetric determination at the capacity of 20 L or below, whilst volumetric method will be used for measurements above 20 L.

5.3.3 The submitted vessels should be in a clean condition.

5.3.4 Calibration charges		Fee in HK$
5.3.4.1	Standard measure at the capacity of 20 L or below, per graduation.	$1970
5.3.4.2	Per additional graduation.	$ 980
5.3.4.3	Standard measure of capacity above 20 L.	Upon Request
5.3.4.4	Soap film burette, per interval.	$3960
5.3.4.5	Per additional interval.	$ 980

5.4 **Hardness** (Enquiry Telephone 2829 4835)

5.4.1 The hardness of a material is, in broad terms, a measure of its resistance to local deformation by some specified disturbing force. Unlike most physical and engineering properties, therefore, hardness is not a unique property, but depends on the nature of the test concerned.

5.4.2 The measured hardness value is the result of a test performed under standard conditions, and is based on a convention. The process of hardness measurement generally comprises three steps :

(i) a test performed under prescribed circumstances (producing the indentation);

(ii) the determination of a characteristic dimension of the indentation (length measurement); and

(iii) the determination of the hardness value from the auxiliary quantity by employing the relevant equation defining the hardness testing method.

5.4.3 The Laboratory can provide hardness measurement of components and indirect verification of hardness testing machines of the following scales :

(i) Vickers

(ii) Rockwell B&C

(iii) Rockwell Superficial

5.4.4 The indirect verification is performed by comparing the values indicated by the hardness testing machine with values of the standard hardness blocks at three points within the working range of the hardness testing machine.

5.4.5 The customer should be aware that several indentation marks will be present on the surface of the test specimen after the hardness measurement.

5.4.6 Calibration charges		Fee in HK$
5.4.6.1	Hardness measurement, for one sample.	$1320
5.4.6.2	Per additional sample.	$ 330
5.4.6.3	Indirect verification of hardness testing machine.	$3950

5.5 **Pressure** (Enquiry Telephone 2829 4835)

5.5.1 The Laboratory is equipped with pressure balances, pressure controllers and precision quartz Bourdon pressure gauges to provide pressure calibration services.

5.5.2 The Laboratory can provide oil pressure calibration services in the gauge mode from 2.3 MPa (23 bar) to 84 MPa (840 bar) for pressure gauges, transducers and pressure transmitters. The Laboratory can also provide gas pressure calibration services in both absolute and gauge modes from 20 kPa (0.2 bar) to 7 MPa (70 bar).

5.5.3 The submitted instrument should be in a clean condition.

5.5.4 For gas pressure calibration, the pressure medium will be nitrogen.

5.5.5 Calibration is generally performed by applying pressures of known values to the unit under test in sufficient number of steps (normally about 7) distributed throughout its usable range, from lower test values to maximum calibration value, and then decreased backwards to initial test value.

5.5.6 Electronic barometer can also be calibrated by this Laboratory, provided that the electronic barometer has a connection for input pressure. Calibration is performed at five points from 800 hPa to 1100 hPa under both rising pressure and falling pressure conditions.

5.5.7 The pressure connections of the submitted instruments should be as follows:

N.P.T.	B.S.P.	A.P.I.	Metric
1/8 in	1/8 in	1/8 in	M12 x 1.5
1/4 in	1/4 in	1/4 in	M20 x 1.5
3/8 in	3/8 in	3/8 in	
1/2 in	1/2 in	1/2 in	

5.5.8 Calibration charges		Fee in HK$
5.5.8.1	Pressure gauge.	$3270
5.5.8.2	Pressure transducer or transmitter.	$3270
5.5.8.3	Electronic barometer.	$3060

5.6 **Torque** (Enquiry Telephone 2829 4835)

5.6.1 The Laboratory can provide calibration services for manually operated torque wrenches and drivers, mechanical torque testers (e.g. torque meter) and electronic torque testers (e.g. torque transducer) from 0.05 to 1 000 Nm.

5.6.2 For torque wrench and driver calibration, the reading of the test instrument will be compared against the reading of a standard torque transducer at, or nearest to, 20%, 60% and 100% of maximum capacity of the submitted instrument unless otherwise requested.

5.6.3 For a precision torque tester, the test device will be calibrated against the torque generated by weights hanging at the end of a beam. Calibration is made by applying torque of known values to the test device in sufficient number of steps (normally about 7) distributed throughout its usable range, from lower test values to full scale capacity.

5.6.4 Calibration charges		Fee in HK$
5.6.4.1	Torque wrench, driver or gauge.	$1550
5.6.4.2	Precision electronic or mechanical torque tester.	$3090

5.7 Liquid Density (Enquiry Telephone 2829 4835)

5.7.1 The Laboratory can provide density determination service for liquids of densities in the range from 650 kg/m^3 to 1600 kg/m^3 using density meter. The operating principle of the density meter is based on the change of the natural frequency of a hollow oscillator when filled with different samples. The oscillator has a constant volume at a given temperature. The natural frequency is related to the mass of the oscillator and hence the density of product contained in it.

5.7.2 The customer may be required to submit the solvent of the test sample for cleaning the density meter after the density measurements.

5.7.3 Calibration charges		Fee in HK$
5.7.3.1	Density determination of a liquid.	$1970

6. FORCE LABORATORY

6.1 Force Measurement (Enquiry Telephone 2798 7347)

6.1.1 The SI unit of force is the newton, N, which is derived from the SI base units of mass (kilogram), length (metre) and time (second). Newton is the force that, when applied to an object with a mass of one kilogram, would give it an acceleration of one metre per second per second.

6.1.2 In practice it is not convenient to create an acceleration of one metre per second per second on an object having a mass of one kilogram in order to realise the standard of force of one newton. Instead the practical realisation of the unit of force makes use of known masses (deadweights) which will produce a known force when subjected to the effect of local acceleration due to gravity. Machines which generate force in this way are called deadweight machines.

6.1.3 The Force Laboratory is equipped with four force standard machines. The two smaller machines are deadweight machines of rated capacities of 5 kN and 60 kN respectively. The two larger machines, which work on hydraulic amplification principle, generate forces up to 3 MN by amplifying the force generated from the 60 kN deadweight machine.

6.1.4 The Force Laboratory provides calibration services for force measuring instruments such as proving rings and load cells in the measuring range from 0.5 kN to 3 MN. Calibration of force measuring instruments of measuring ranges from 0.5 kN to 60 kN will generally be performed by using the two deadweight machines which are capable of generating forces with an uncertainty of ± 0.002%. For force measuring instruments of measuring ranges from 60 kN up to 3 MN, calibration will normally be performed by using the two hydraulic force machines. The uncertainties of the forces generated by these machines are ± 0.02% and ± 0.05% respectively. The uncertainties quoted on the calibration certificate will include the uncertainties due to the instrument under test itself during the calibration.

6.1.5 Calibration of force measuring instruments would normally involve the following tests :

6.1.5.1 Compression and/or Tension Tests :

Calibration is based on clause 6.4.2 of BS EN 10002-3 : 1995, such that four series of calibration forces are applied to the force measuring instrument for each operation mode (i.e. tension or compression). For each measuring series, the forces are applied in sufficient number of equal steps (normally 10) distributed evenly throughout the usable range of the force measuring instrument.

6.1.5.2 Overloading Test :

Prior to the calibration, an overloading test will be performed in accordance with clause B.1 of Annex B of BS EN 10002-3 : 1995, such that the force measuring instrument is subject 4 times in succession to an overload of about 110% of its capacity. The charge for the overloading test is included in the charge for the tension or compression test.

6.1.5.3 Bearing Pad Test :

The bearing pad test and variable voltage test may also be offered upon request from the customer. The bearing pad test, which applies only to compression force measuring instruments, is for assessing the interaction between a force measuring instrument and its support on the force standard machine. This test will be performed in accordance with clause B.2 of Annex B of BS EN 10002-3 : 1995, and is recommended only for new instrument or instrument after repair.

6.1.5.4 Variable Voltage Test :

The variable voltage test is applicable to force measuring instruments requiring electrical supply for operation as mentioned in clause 6.1.3 of BS EN 10002-3 : 1995. The test is to verify that a variation of ± 10% of the supply voltage has no significant effect on the force measuring instrument. In this test, the change in the readings of the force measuring instrument under test will be reported when the supply voltage is varied between ± 10% of the rated voltage. The applied force during this test will be the rated capacity of the force measuring instrument under test.

6.2 Calibration charges		Fee in HK$
6.2.1 For force measuring instruments in measuring range up to 60 kN		
6.2.1.1	Tension test including overloading test.	$4080
6.2.1.2	Compression test including overloading test.	$4080
6.2.1.3	Bearing pad test.	$2380
6.2.1.4	Variable voltage test.	$1020

Calibration charges		Fee in HK$
6.2.2	For force measuring instruments in measuring range above 60 kN up to 3 MN	
6.2.2.1	Tension test including overloading test.	$4760
6.2.2.2	Compression test including overloading test.	$4760
6.2.2.3	Bearing pad test.	$3060
6.2.2.4	Variable voltage test.	$1360

7. HUMIDITY LABORATORY

(Enquiry Telephone 2829 4842)

7.1 General

7.1.1 Humidity is a measure of the water vapour present in the air or in other gases. Because of the very wide interest in humidity, it is expressed in many different but inter-related ways. Those interested in very low concentrations, for instance, would probably express their measurements in parts per million; others concerned with higher levels of humidity are more likely to specify dew point or partial pressure of water vapour; and those interested in the effect of water vapour on materials usually prefer measurements in relative humidity.

7.1.2 The Laboratory maintains the official reference standards of humidity measurements for Hong Kong.

7.1.3 The Laboratory provides calibration services for the following types of instruments :

(a) Dew-point instruments, Range : -60 °C to 65 °C.

(b) Psychrometers.

(c) Electronic relative humidity instruments.

(d) Thermohygrographs/Temperature and humidity recorders.

For (b), (c) and (d), the temperature and humidity ranges are interrelated. The maximum ranges are:

temperature : 5 °C to 70 °C.

humidity : 8% to 95% RH

7.2 Dew-point Hygrometers

7.2.1 In a dew-point hygrometer, air to be tested is drawn through a chamber containing a clean and highly polished mirror. A beam of light is directed on to the mirror and the reflected beam is monitored electronically in order to detect and control the formation of dew or frost.

7.2.2 To calibrate a dew-point hygrometer, a stream of low flow rate air, generated by a standard humidity generator and at the specified dew-point temperature, is passed through both the UUT and reference dew-point hygrometers which are then compared.

7.2.3 Calibration		Fee in HK$
7.2.3.1	Calibration at one dew- charges point temperature.	$2240
7.2.3.2	Calibration at each additional dew-point temperature.	$ 810

7.3 Psychrometers

7.3.1 In a psychrometer, two temperature sensing elements are exposed to a stream of air; they are usually platinum resistance elements or mercury-in-glass thermometers. One of the elements (the wet bulb) is covered by a closely fit sleeve of a material such as cotton, which is thoroughly moistened with water. The other element (the dry bulb) is uncovered and dry. The wet and dry temperatures are used to compute the relative humidity.

7.3.2 Electronic psychrometers contain electric thermometers and usually incorporate a processor so the relative humidity can be calculated from the dry and wet element temperatures and displayed.

7.3.3 The psychrometers are calibrated by comparing against the Laboratory standards at the specified sets of temperature and humidity condition.

7.3.4 Calibration charges		Fee in HK$
7.3.4.1	Calibration at one humidity/temperature combination.	$2240
7.3.4.2	Calibration at each additional humidity/ temperature combination.	$ 810

7.4 Electronic Relative Humidity Instruments

7.4.1 Over the years devices other than the wet and dry bulb psychrometer have evolved which permit a direct measurement of relative humidity. These sensors are, for the most part, electrochemical sensors which offer a degree of ruggedness, compactness and electronic readout ability.

7.4.2 The two most widely used electronic relative humidity sensors are the lithium chloride condensation sensor and the electric-impedance humidity sensor.

7.4.3 These sensors are calibrated by comparing against the Laboratory standards at the specified sets of temperature and humidity condition.

7.4.4 Battery operated units must be submitted with batteries which are in good working condition, and fully charged. It is advisable to submit the battery charger or AC/DC adapter as well.

7.4.5 Calibration charges		Fee in HK$
7.4.5.1	Calibration at one humidity/temperature combination.	$2240
7.4.5.2	Calibration at each additional humidity/ temperature combination.	$ 810

7.5 Thermohygrographs/Temperature and Humidity Recorders

7.5.1 Thermohygrographs/temperature and humidity recorders can usually record continuously the temperature and humidity readings on a chart. For a thermohygrograph, the sensor and the recording mechanism are usually housed in the same cabinet. Other designs of temperature and humidity recorder usually employ the combination of an electronic temperature/humidity sensor/meter and an electrical chart recorder.

7.5.2 The thermohygrographs/temperature and humidity recorders will be calibrated by comparing against the Laboratory standards in the calibration chamber of a humidity generator.

7.5.3 Calibration charges		Fee in HK$
7.5.3.1	Calibration at one humidity/temperature combination.	$1980
7.5.3.2	Calibration at each additional humidity/ temperature combination.	$ 730